

REMARKS

Reconsideration of the application is requested.

Claims 10-27 are now in the application. Claims 10-27 are subject to examination. Claims 10, 11, and 19 have been amended. Claims 22-27 have been added.

An RCE has been filed concurrently with this response.

Under the heading "Claim Rejections – 35 USC § 103" on page 3 of the above-identified Office Action, claims 10-21 have been rejected as being obvious over Published German Patent Application No. DE 19 944 733 to Schrod in view of U.S. Patent No. 6,330,510 to Takaku et al. under 35 U.S.C. § 103.

Applicants first note that claim 10 includes a step of: acquiring an external measured variable in the form of a pressure at the valve. Claim 19 specifies: said regulator having an input connected to at least one sensor for detecting a pressure at the valve defining a second controlled variable.

The Examiner has alleged that Takaku et al. teach the features of claims 10 and 19 that have been copied above. Takaku et al., however, do not teach measuring or detecting the pressure at the fuel injection valve 10, but rather teach a cylinder pressure sensor 12 for measuring the pressure inside the

combustion chamber 9 (See column 4, lines 53-57 and Fig. 1 of Takaku et al.).

The invention as defined by claims 10 and 19 could not have been suggested by the teachings in Schrod and Takaku et al. because neither reference teaches or suggests the features of claims 10 and 19 that have been copied above.

Claims 10 and 19 have been amended to even better define the invention. Claims 22-27 have been added. Support for the changes can be found by referring to the specification at page 2, line 25 through page 3, line 32 and at page 12, line 23 through page 14, line 15. In particular, see page 3, lines 12-23, which explains that the actuator can be directly charged or discharged from any valve position to any other valve position, and page 3, lines 25-32, which explains that the charging or the discharging is controlled according to a specified control action corresponding to a specified setpoint value for the charge state. Support for claims 26 and 27 can be found by referring to claim 1 and to the specification at page 4, lines 1-15 and at page 14, lines 13-15. Claim 11 has been amended to be consistent with the changes to claim 10.

Claim 10 defines a control method for a valve actuator that includes a step of: charging and/or discharging the actuator in accordance with a control action to move the actuator to a predetermined first open valve position specified by a first setpoint value and charging and/or discharging the actuator in accordance with the control action to move the

actuator from the first open valve position to a predetermined second open valve position specified by a second setpoint value such that the actuator is not substantially completely discharged while moving from the first open valve position to the second open valve position, the first open valve position and the second open valve position corresponding to a respective charge state. Claim 19 includes similar limitations.

In contrast to the invention as defined by claims 10 and 19, Schrod teaches a well known method and control device in which the actuator must be substantially completely discharged before it can again be moved into an open position specified by a setpoint value (See the voltage Up at time t4 in Fig. 2 and column 5, lines 17-22 of the corresponding U.S. Patent to Schrod). For this reason even if Takaku did suggest the features that have been alleged by the Examiner, the invention as now defined by claims 10 and 19 would not have been suggested.

In the Response to Arguments section, the Examiner has stated that as "Schrods actuator voltage increases during time t1 to t2, the injector valve transitions through different positions." Applicants note that as the actuator voltage increases during the time from t1 to t2, the actuator is not being moved from one predetermined open position specified by a first setpoint value to another predetermined open position specified by a second setpoint value. Schrod teaches only one predetermined open position that is specified by one setpoint value. The predetermined open position occurs when the

predetermined actuator voltage U_p is reached. For this reason even if Takaku did suggest the features that have been alleged by the Examiner, the invention as now defined by claims 10 and 19 would not have been suggested.

Furthermore, Takaku et al. do not teach the features of claims 10 and 19 that have been alleged by the Examiner. Claim 10, for example, specifies:

during an idle time between two consecutive chargings or dischargings, determining a controlled variable reflecting the charge state of the actuator and/or a valve position;

acquiring an external measured variable in the form of a pressure at the valve; and

during an idle time between two consecutive chargings or dischargings, regulating the **control action** in dependence on the controlled variable and, additionally, on the external measured variable.

Claim 10 also specifies that the actuator is charged and/or discharged in accordance with the **control action**.

Takaku et al. do not teach regulating the control action, which is used to charge and/or discharge the actuator, in dependence on an external measured variable in the form of a pressure at the valve. Takaku et al. teach a diagnostic method in which a malfunction is detected and a warning is given (See Figs. 3-5). Column 5, line 66 through column 6, line 17 teach that the

signal from the pressure sensor 12 is supplied to the CPU 30 of an electronic control unit 20, but there is no specific teaching relating to how the signal from the pressure sensor 12 is used. It is merely mentioned that the CPU 30 calculates signals representing the ignition time, injector driving pulse width, injector driving time, throttle valve opening, and swirl control valve opening. The CPU 30 also receives signals from the air flow sensor, the throttle opening sensor, the air fuel sensor and the crank angle sensor. There is no teaching that the signal from the pressure sensor 12 is actually used to regulate the charging and/or discharging of the actuator. Additionally, as has already been pointed out above, the pressure sensor 12 does not measure the pressure at the fuel injection valve 10, but rather measures the pressure inside the combustion chamber 9.

The invention as now defined by claims 10 and 19 would not have been suggested by the teachings in Schrod and Takaku et al.

New claims 22-25 even further distinguish the invention from the prior art by specifying that the actuator is either exclusively discharged or exclusively charged in order to move from the first open valve position to the second open valve position. In order for the actuator of Schrod to move to two open valve positions corresponding to two different set points, the actuator would have to be discharged to the state shown at t4 in Fig. 2 and then charged again as shown at time t1 in Fig. 2.

New claims 26 and 27 even further distinguish the invention from the prior art by specifying that the control action takes effect when a subsequent setpoint value is used to specify a subsequent open valve position. Column 5, lines 50-57 of Schrod teach that the actuator voltage is compared with threshold values and that the actuator voltage is identified with a specific energy or charge. It is also taught that when the actuator slowly discharges because of parasitic resistances, the actuator can be recharged during a lengthy hold phase. This recharging is of course used to maintain the actuator at the current setpoint. There is no teaching related to a control action that takes effect when a subsequent setpoint value is used to specify a subsequent open valve position

Under the heading "Claim Rejections – 35 USC § 103" on page 9 of the above-identified Office Action, claims 10-21 have been rejected as being obvious over Published German. Patent Application No. DE 19 944 733 to Schrod in view of U.S. Patent No. 6,330,510 to Takaku et al. and further in view of U.S. Patent Application Publication No. 2001/0035465 to Shinogle et al. under 35 U.S.C. § 103.

As discussed above, Schrod and Takaku et al. would not have suggested the invention as defined by claims 10 and 19.

Additionally, in contrast to the invention as defined by claims 10 and 19, the actuator taught by Shinogle et al. is de-energized or discharged to the closed

state in the process of going from one predetermined open valve position to another predetermined open valve position (paragraphs 18 and 19). See paragraph 0018, which teaches, "Between injection events, piezo-electric actuator 30 is de-energized, outlet control passage 25 is closed and needle valve member 40 is in its downward closed position" (underlining added). Whereas the actuator 30 can be charged to any predetermined open position according to a setpoint value, after the actuator 30 reaches that predetermined open position, the actuator 30 is discharged to the closed position before going to another predetermined open position that is specified by another setpoint value.

Shinogle et al. clearly teach that between the small pilot injection and the ramp shaped main injection, the actuator voltage returns to zero and the actuator is substantially completely discharged as shown in Fig. 2. The flow rate shown in Fig. 3 also shows that the actuator is substantially completely discharged when the actuator voltage returns to zero since the actuator returns to the closed valve position.

It is clear that the actuator of Shinogle et al. is substantially completely discharged in order to move from a predetermined first open valve position specified by a first setpoint value to a predetermined second open valve position specified by a second setpoint value. The teachings in Schrod, Takaku et al. and Shinogle et al. would not have suggested the invention as defined by claims 10 or 19.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claims 10 or 19. Claims 10 and 19 are, therefore, believed to be patentable over the art. The dependent claims are believed to be patentable as well because they all are ultimately dependent on claim 10 or claim 19.

In view of the foregoing, reconsideration and allowance of claims 10-27 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate receiving a telephone call so that, if possible, patentable language can be worked out.

Petition for extension is herewith made. The extension fee for response within a period of one month pursuant to Section 1.136(a) in the amount of \$130.00 in accordance with Section 1.17 is enclosed herewith.

Please charge any other fees that might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner Greenberg Sterner LLP, No. 12-1099.

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Respectfully submitted,

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MPW:cgm

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